

OCR A Level

Computer
Science

H446 – Paper 1

2

Database concepts

Unit 4

Exchanging data



PG ONLINE

Objectives

- Explain the concept of a relational database
- Define the terms flat file, entity, attribute, primary key, foreign key, secondary key, entity relationship modelling, referential integrity
- Produce an entity relationship model for a simple scenario involving multiple entities

A simple database

- The simplest kind of database is a flat file, consisting of information about a single **entity**
- Definition: An entity is a category of object, person, event or thing of interest about which data needs to be recorded
- For example you might hold data about club members or concert venues

Database design

- Most databases hold data about several entities
- Suppose you are going to design a new system for a company selling subscriptions for online revision guides
- Where do you start?

Looking at the data

- One of the first things you need to do is look at the data
- What entities are there in a system that will keep records of subscriptions for revision guides?

Entities

- You may have thought of these entities:
 - Customer
 - Guide or Product
 - Subscription
- Other entities that could be considered include customer order, subject, author (of a revision guide)
- We will keep it simple and just consider **Customer**, **Product** and **Subscription**
- What data would you keep about each of these entities?

Writing an entity description

- This will be a database system, called **RevisionSubs**
- Each entity in the database has attributes
- The entity descriptions can be written in this format:
 - Customer (custID, title, firstname, surname, email)
 - Product (productID, title, subject, level, price)
 - Subscription (subID, startDate, endDate)

Entity identifier (primary key)

- Each entity needs an **identifier** which uniquely identifies a particular record
- In a relational database, the identifier is known as the primary key
- It is underlined in the entity description:
 - Customer (custID, title, firstname, surname, email)
 - Product (productID, title, subject, level, price)
 - Subscription (subID, startDate, endDate)
- If there is no natural attribute for a primary key, one should be introduced

Composite primary key

- Sometimes two or even more attributes are needed to uniquely define a record
- For example, in a customer order consisting of many different order lines, each order line may be uniquely identified by the two attributes **orderNumber** and **orderLine**
- OrderLine (OrderNumber, OrderLine, ProductID, ...)
- OrderNumber, OrderLine is a **composite primary key**

Secondary key

- The primary key field is automatically **indexed** so that any particular record can be found very quickly
- In some databases, searches may often need to be made on other fields
- In the product table,

Product (productID, title, subject, level, price)

if searches often need to be made on title or subject, either or both of these fields could be defined as a **secondary key**

- They would then be indexed for faster lookups

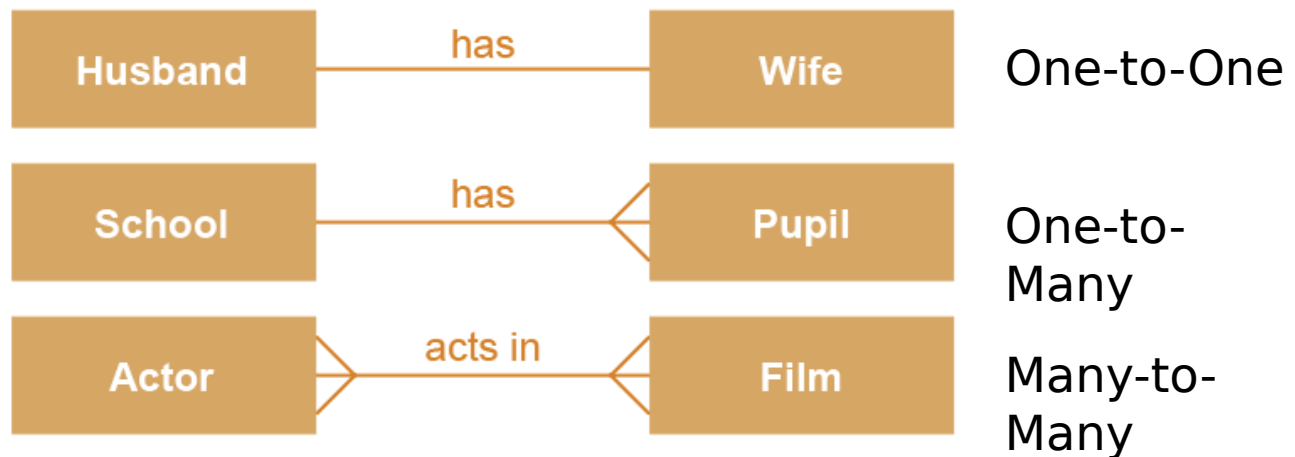


Relationships between entities

- The three entities are linked, or related
- There are three possible ways in which two entities may be related:
 - One-to-one e.g. Husband and Wife
 - One-to-many and Pupil e.g. Mother and Child, School
 - Many-to-many e.g. Actor and Film, Recipe and Ingredient
- What is the relationship between **Customer** and **Subscription**?
- What is the relationship between **Product** and **Subscription**?

Entity relationship diagrams

- An entity relationship (E-R) diagram is a graphical way of representing the relationships between entities



- We can say, for example, that one school has many pupils, or many pupils attend one school

E-R diagram

- There is a one-to many relationship between Customer and Subscription
 - One customer may have several subscriptions, but a particular subscription belongs to only one customer
- There is a one-to-many relationship between Product and Subscription
 - One product may appear on several subscriptions, but a subscription is for only one product



Database structure

- Each entity is represented by a table
- Tables in a relational database are commonly referred to as **relations**
- A database contains one or more relations
- A relation has rows, each row containing one record
- The columns in the relation each contain one field (i.e. attribute) belonging to the records

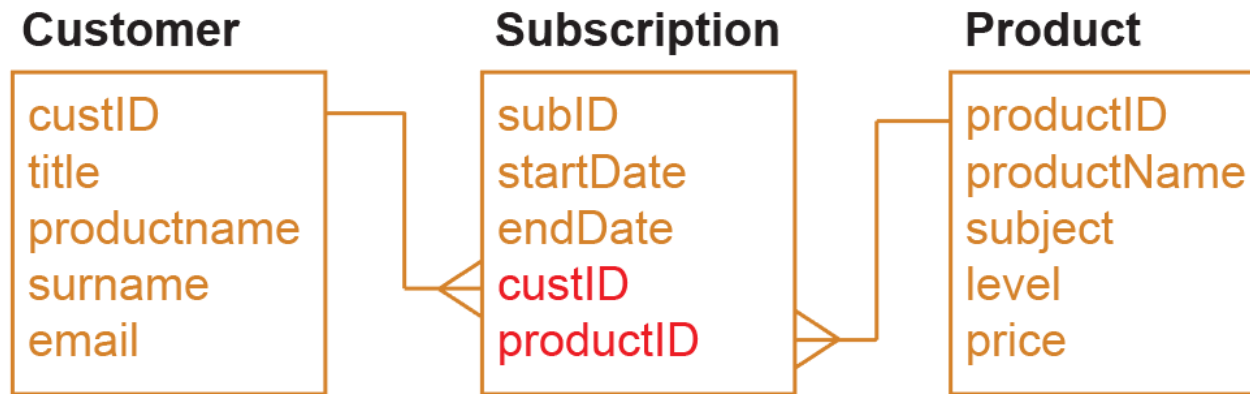
Creating a relationship

- To create a relationship between Customer and Subscription, we need to include custID in the entity description of Subscription
 - Subscription (subID, startDate, endDate, custID)
- ProductId also needs to be included in the entity description of Subscription
 - Subscription (subID, startDate, endDate, *custID*, *productID*)
- custID and productID are **foreign keys** in Subscription, shown in italics
 - A foreign key always goes on the “many” side of a relationship



Foreign key: definition

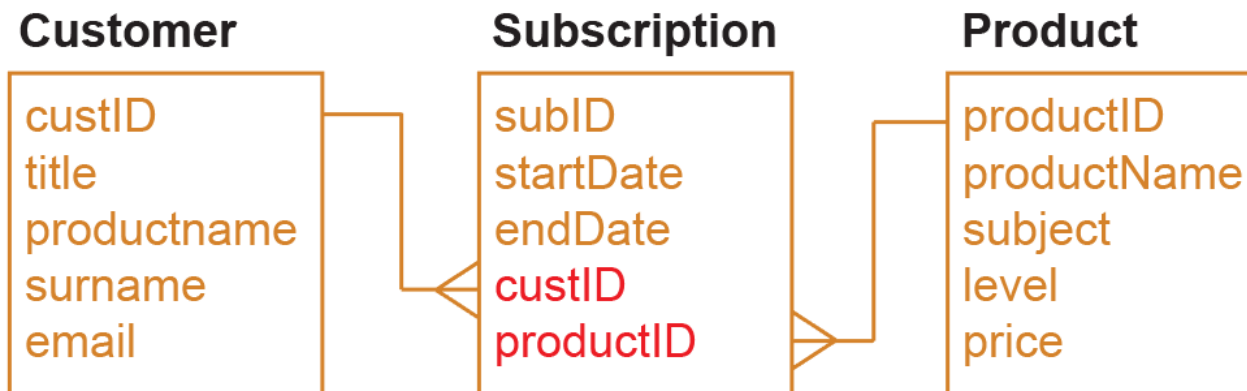
- A foreign key is an attribute that creates a join between two tables (relations)
- It is the primary key in the first relation



- Draw an entity relationship diagram to show the relationships between the three entities

Referential integrity

- Referential integrity means that no foreign key in one table can reference a non-existent record in a related table
- For example, it should not be possible to add a subscription for a customer with custID C100 if there is no record for customer C100



The RevisionSubs database

- The tables (relations) on the next slide represent the three entities described, each with its own attributes
- We will use the convention of giving each table name the prefix **tbl**
 - Each table contains some sample data

Revision Subs tables

tblCustomer

custID	title	firstname	surname	email
C111	Mr	Fred	Carr	fcarr53@gmail.com
C245	Miss	Mabel	Jenkins	mabel777@bt.com
C364	Miss	Jasmine	Kumar	jkumar@icloud.com

tblSubscription

subID	startdate	endDate	custID	productID
S1211	25/02/2016	24/02/2017	C111	P36
S1212	01/02/2016	31/01/2017	C111	P47
S1213	04/02/2016	03/02/2017	C245	P36

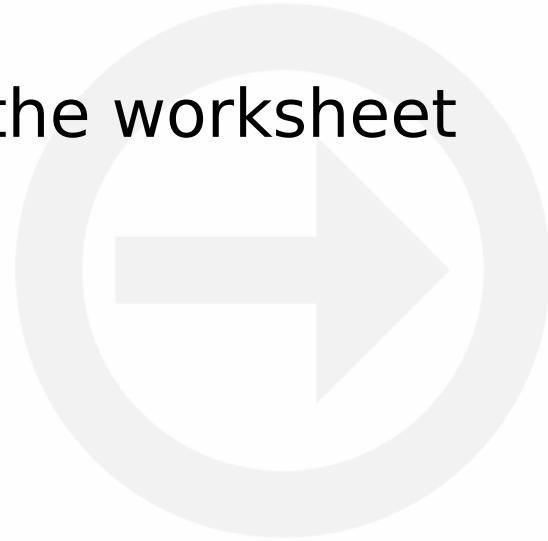
tblProduct

productID	productName	subject	level	price
P24	Equations	Maths	2	£12.00
P36	Programming	Comp Science	4	£25.00
P47	Database	Comp Science	4	£25.00



Worksheet 2

- Do **Task 1** and **Task 2** on the worksheet



Many-to-many relationships

- When there is a many-to-many relationship between tables, they cannot be directly linked
 - For example, you cannot link the entities Customer and Product directly



- Why not?

Many-to-many relationships

- You would need several fields in tblCustomer to hold the ProductID of each product a customer has subscribed to
- But how many fields would you allow?
 - How would you find all customers who had subscribed to a particular product?

custID	title	firstname	surname	email	ProdID 1	ProdID 2
C111	Mr	Fred	Carr	fcarr53@gmail.co m	P36	P47
C245	Miss	Mabel	Jenkins	mabel777@bt.co m	P36	
C364	Miss	Jasmine	Kumar	jkumar@icloud.co m	P25	P36



Many-to-many relationships

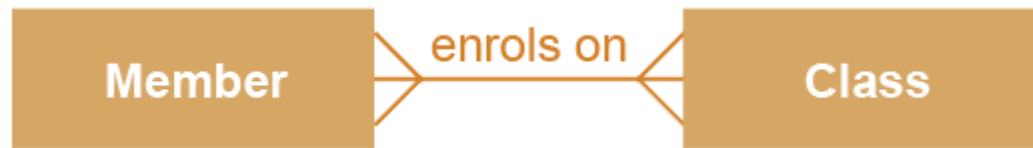
- This configuration does not work
- It is impractical to allow several fields ProdID1, ProdID2, etc.
- You cannot easily extract information from this table
- An alternative way of organising the data is required

custID	title	firstname	surname	email	ProdID 1	ProdID 2
C111	Mr	Fred	Carr	fcarr53@gmail.co m	P36	P47
C245	Miss	Mabel	Jenkins	mabel777@bt.co m	P36	
C364	Miss	Jasmine	Kumar	jkumar@icloud.co m	P25	P36



Linking tables

- Suppose you have a table holding details of gym members and the classes they take – yoga, indoor cycling, pilates, interval training, etc.



- You need a link table “in the middle” just as the entity Subscription was between



Plenary

- Identifying entities and drawing an entity relationship diagram is the first step in designing a database
- Many-to-many relationships cannot be represented in database tables; an extra table is required
 - Note that the “many” side of the two resulting one-to-many relationships is always the link table



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